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ABSTRACT

Print materials in astronomy such as books, journals, charts, and posters are typically the sources of information for teachers and children about the moon, the sun, lunar and solar eclipses, planetary sizes, distances of planets from the sun, planetary atmospheres, and so on. This paper describes and analyzes a number of activities designed to develop primary school children's observation skills and relevant understandings in astronomy. The activities are based on data contained in a 1995 astronomy yearbook, Astronomy-1995 (Eastern Australian Edition). The key concepts of position, time, and motion are embedded into each activity with the underlying objective that children should acquire the skills to become competent naked-eye astronomers. Activities described include: monthly viewing programs, sunrise and sunset problems, the sun-geocentric position, and planetary motion. (Author/JRH)

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ACTIVITY BASED ASTRONOMY FOR PRIMARY SCIENCE PROGRAMS

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ABSTRACT

This paper describes and analyses a number of activities designed to develop primary school children's observation skills and relevant understandings in astronomy. The activities, based on data contained in a 1995 astronomy yearbook, will be applicable to subsequent yearbooks. The key concepts of position, time and motion are embedded into each activity with the underlying objective being that children should acquire the skills to become competent 'naked eye' astronomers.

INTRODUCTION

Print materials in astronomy such as books, journals, charts and posters, are typically the sources of information for teachers and children about the moon, the sun, lunar and solar eclipses, planetary sizes, distances of planets from the sun, planetary atmospheres, and so on. However, most print materials are not overtly the sources of many activities suitable for children in primary schools. The purpose of this paper is to analyse a specific print resource, readily available at modest cost, that can be used as the basis of a variety of interactive, hands-on activities for teaching and learning astronomy. The provision of hands-on activities in astronomy is vitally important so that children can become confident and competent 'naked eye' observers.

The print resource examined in detail is the current issue of Astronomy-1995 (Eastern Australian Edition) compiled by Dawes, Northfield and Wallace (1995). The activities described in this paper will be presented in the same sequence as the relevant section of Astronomy-1995. There are a number of yearbooks similar to Astronomy-1995 prepared by various astronomical societies and organisations. They are not identical publications, however, each one represents a valuable source of data and background information suitable for the planning and implementation of short and long term astronomy programs. The activities described in this paper would be applicable, with minor adaptations, to subsequent yearbooks, and can be used to supplement activities with sundials and lunar observation programs described elsewhere (Ginns, 1993).

ACTIVITY 1: MONTHLY VIEWING PROGRAMS

Astronomy-1995 presents a diary of interesting astronomical events for each month of the year accompanied by "sky view" diagrams for selected dates in the relevant month. Notes are also provided about viewing the moon and the planets during the particular month. The diaries are potentially an important source of monthly or year long viewing schedules for children, as there are many opportunities for 'naked eye' observation of important events and objects in any month. A useful method for initiating naked eye observation work is to select events from the diary where the

moon is in very close proximity to another object, for example, the planet Jupiter, and/or observe the moon at different points of the lunar cycle. Effectively the teacher is encouraging children to use the moon as a 'signpost' for locating other objects in the sky. Table 1 contains a list of events extracted from Astronomy-1995 that children can observe with the naked eye for the month of November. It is essential that children have a sound understanding of direction, particularly North, before commencing 'naked eye' viewing programs.

TABLE 1

NAKED EYE OBSERVATION EVENTS (NOVEMBER, 1995)

DATE	EVENT	SUGGESTED VIEWING TIME	COMMENT
03.11.95	Saturn 6° south of moon	07.00pm	Saturn will be slightly south west of the moon at the suggested time.
07.11.95	Full moon	07.00pm	
15.11.95	Last quarter moon	07.00am	Best viewing time for children.
24.11.95	Jupiter 4° south of moon	07.00pm	Moon will be seen as a thin crescent. Jupiter will be slightly south west of the moon at the suggested time.
	Mars 5° south of moon	07.00pm	Interesting to see Jupiter, Mars and Venus in apparent close proximity in the same area of the sky.
	Venus 6° south of moon	07.00pm	
29.11.95	First quarter moon	07.00pm	
30.11.95	Saturn 6° south of moon	07.00pm	As for 03.11.95

It should be noted that some of the detail contained in the yearbook has been adjusted in Table 1 to permit more convenient viewing times for young children. Some alterations in viewing times should be made for daylight saving periods in various states. In any month there are at least 6 events that can be easily observed with the naked eye. In addition, the "sky view" diagrams can be used as a visual aid to guide children's' identification and viewing of various planets.

ACTIVITY 2: SUNRISE AND SUNSET PROBLEMS

The general notes and discussion about the solar system which open the second part of the yearbook, e.g. defining the orbital aspects of planets and explaining the phenomenon of retrograde

motion, represent an excellent source of background information for teachers. A table of solar system data can form the basis of activities in which children construct models to represent the different sizes of the planets or the different distances of the planets from the sun. Other data in the table include the masses, volumes, and the sidereal and synodic periods of the planets.

An examination of the rise and set times for the sun at various locations in Australia is a worthwhile activity for children. A selection of sunrise and sunset times at Brisbane for a calendar year are shown in Table 2. These data are also plotted in Figure 1.

TABLE 2.

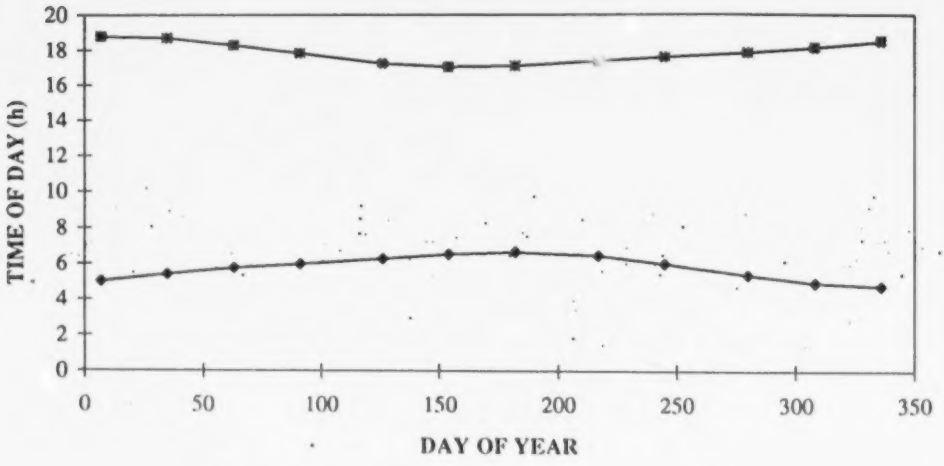
SUNRISE AND SUNSET TIMES (BRISBANE

DATE	DAY COUNT OF YEAR	SUNRISE TIME (00h.00m)	SUNSET TIME (00h.00m)
Jan-07	007	5.00	18.48
Feb-04	035	5.22	18.41
Mar-04	063	5.42	18.17
Apr-01	091	5.57	17.47
May-06	126	6.16	17.13
Jun-03	154	6.31	17.01
Jul-01	182	6.39	17.04
Aug-05	217	6.27	17.21
Sep-02	245	6.01	17.35
Oct-07	280	5.22	17.51
Nov-04	308	4.55	18.08
Dec-02	336	4.45	18.30

The figure clearly shows the reduction in daylight hours as winter approaches and the gradual lengthening of the days from June 22 to the summer solstice. Children can construct a similar figure for the capital city in their state using the data in Astronomy-1995 and also compare results for different capital cities in Australia. Moon rise and moon set data for the capital cities are also provided in the yearbook.

FIGURE 1

SUNRISE/SUNSET TIMES (BRISBANE)



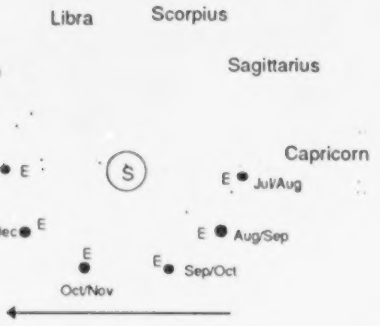
ACTIVITY 3: THE SUN - GEOCENTRIC POSITION

An understanding of the coordinate system Right Ascension and Declination is required for this activity. This system is used to fix the position of objects in the sky with reference to the celestial equator. A celestial globe can be used to illustrate ideas such as, (a) the celestial equator, (b) the ecliptic, (c) Right Ascension measured in hours along the celestial equator, and (d) Declination measured in degrees to the North or South of the celestial equator. Zero hours right ascension is located at the Vernal Equinox (in the case of the southern hemisphere - Autumnal Equinox, March 21), the intersection of the celestial equator and the ecliptic. The ecliptic is the sun's apparent path through the sky during the year. Declination is assigned a positive sign to the North of the celestial equator and a negative sign to the South of the celestial equator. Right Ascension and Declination are analogous to earth's map coordinate system, longitude and latitude, respectively.

Charts consisting of drawings or pictures of at least six consecutive signs of the Zodiac, should be distributed around a room as shown in Figure 2. When viewed by observers on earth, the sun is in the constellations of the Zodiac as shown in the diagram. The motion of the earth in its orbit around the sun, for a viewer located in the southern hemisphere, is designated with the arrow.

FIGURE 2

MODELLING THE GEOCENTRIC POSITION OF THE SUN



ACTIVITY 4: PLANETARY MOTION

Examine the Ephemeris of Jupiter, in particular, the Right Ascension and Declination of the planet during 1995. The data in Table 3, extracted from Astronomy-1995, indicate that Jupiter moved in an easterly direction until the end of March, appeared to stop in early April, apparently moved backwards during April to early August, appeared to stop again in August, finally resuming its easterly motion from August to the end of the year. The data can be plotted on a graph similar to the one shown in Figure 3.

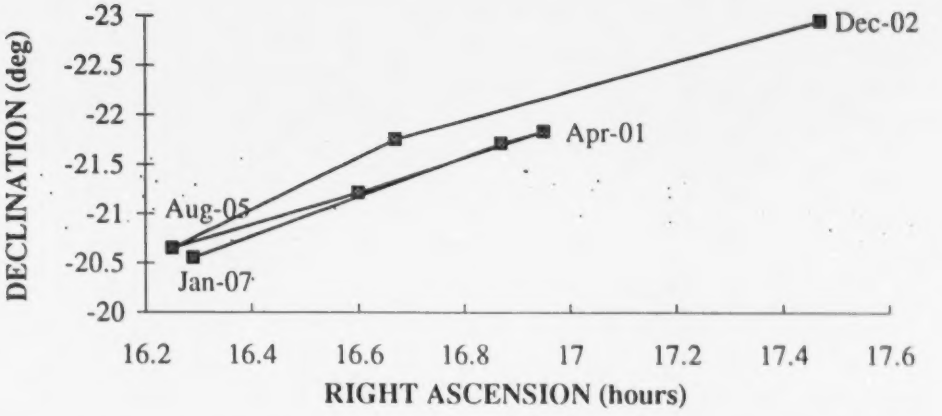
TABLE 3

RIGHT ASCENSION AND DECLINATION FOR JUPITER - 1995

DATE	RIGHT ASCENSION (h)	DECLINATION (°)
Jan-07	16.29	-20.55
Mar-04	16.87	-21.71
Apr-01	16.95	-21.83
Jun-03	16.60	-21.21
Aug-05	16.25	-20.65
Oct-07	16.67	-21.75
Dec-02	17.47	-22.95

FIGURE 3

PLANETARY MOTION - JUPITER 1995



The apparent reverse motion of the planet is called retrograde motion. Several models can be used to visualise this phenomenon, e.g. a car overtaking another on the highway, or an athlete in an inside lane of a running track passing an athlete in an outside lane. In order to effectively use the finder charts that accompany the planetary data, the teacher should face North and view the picture by holding it over his/her head with the top of the page pointing North. Figure 3 should be used in a similar manner, however, in this case the top of the page should point South.

The planisphere is a valuable additional resource for this type of activity. Teachers should familiarise themselves with the relevant markings for the celestial equator, the Right Ascension and Declination lines. Attempt reading the values for the Right Ascension and Declination of some well known stars and constellations, e.g. Sirius and the Southern Cross respectively. The correct method of setting the planisphere for date and time should also be practised as well as the method for orienting and using the instrument. Finding and mapping the positions of visible planets in the night time sky with the aid of a planisphere and the tables of relevant Right Ascension and Declination are feasible year long projects for children to undertake. The planisphere is also a useful tool for finding and identifying easily recognised constellations such as Orion, Scorpio and Canis Major.

CONCLUSION

In this article I have attempted to demonstrate that an astronomy yearbook such as Astronomy-1995 can be the source of many interesting hands-on activities for primary school children. A teacher should now view this type of resource as being more than just a compilation of complex facts and figures which have little value and meaning for the non-expert. For instance, the diaries of astronomical events are particularly for initiating naked eye viewing programs. The complete tables of data can be daunting, however, extracts can be selectively used as illustrated in Activities 2, 3 and 4. These activities may require more teacher guidance and, arguably, are better suited to the upper primary grades. Yet, if the activities are implemented, they can contribute to the development of children's observation

skills and the acquisition of knowledge essential for acquiring a deeper understanding of astronomy.

ACKNOWLEDGMENTS

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